

437

WHAT IS CLAIMED IS:

1. A drug pump for dispensing fluid to a patient comprising:

- a pump mechanism for pumping fluid;
- a processor electrically connected to the pump mechanism;
- a flash memory electrically connected to the processor for storing pump application information for control and operation of the pump mechanism;
- a communication port electrically connected to the processor to permit transfer of pump application information to the flash memory from an exterior of the pump;
- a communications cable sensor associated with the communications port, the communications cable sensor electrically connected with the processor, the communications cable sensor sending a signal to the processor indicative of the presence of a cable plugged into the communication port;
- a reprogrammable memory electrically connected to the processor and separate from the flash memory for storing patient specific settings;
- a keyboard electrically connected to the processor usable to enter the patient specific settings; and
- a display electrically connected to the processor.

2. The drug pump of claim 1, further comprising a boot program stored within the flash memory to permit the initialization and loading of pump application information to the drug pump via the communications port.

3. The drug pump of claim 1, further comprising:

a pump program stored within the flash memory to control operation of the pump mechanism; and

a plurality of patient specific settings stored in the reprogrammable memory, the pump application program accessing the patient specific settings to control operation of the pump mechanism.

4. The drug pump of claim 3, further comprising a plurality of pump application programs stored within the flash memory.

5. The drug pump of claim 4, wherein one of the pump application programs is a closed loop testing application program for closed loop testing of the pumping mechanism.

6. The drug pump of claim 4, wherein one of the pump application programs is a master application program for pump to pump communication.

7. The drug pump of claim 6, wherein one of the pump application programs is a closed loop testing application program for closed loop testing of the pumping mechanism and further comprising:

a cassette identification sensor electrically connected to the processor for identifying a predetermined cassette mounted to the pump mechanism;

an occlusion sensor electrically connected to the processor for detecting an occlusion in a tubing of a cassette mounted to pump mechanism;

a latch for latching a cassette to the pump mechanism;

a lock for locking the latch in the latched state;

a latch sensor electrically connected to the processor for sensing when the latch is in the latched state; and

a lock sensor electrically connected to the processor for sensing when the lock is in the locked state.

8. The drug pump of claim 1, further comprising a cassette identification sensor electrically connected to the processor for identifying a predetermined cassette mounted to the pump mechanism.

9. The drug pump of claim 1, further comprising an occlusion sensor electrically connected to the processor for detecting an occlusion in a tubing of a cassette mounted to pump mechanism.

10. The drug pump of claim 1, further comprising:

a latch for latching a cassette to the pump mechanism;

a lock for locking the latch in the latched state;

a latch sensor electrically connected to the processor for sensing when the latch is in the latched state; and

a lock sensor electrically connected to the processor for sensing when the lock is in the locked state.

11. The drug pump of claim 1, further comprising a cassette mounted to the pump mechanism, the cassette including a tubing, and a pressure plate, the tubing positioned between the pressure plate and the pump mechanism.

12. The drug pump of claim 11, further comprising a fluid reservoir connected to the tubing for fluid communication.

13. The drug pump of claim 1, further comprising a cable and a digital simultaneous voice and data modem connected to the communications port by the cable.

14. The drug pump of claim 1, further comprising autolock program means for automatically locking access to the processor following a reprogramming operation of the drug pump.

15. The drug pump of claim 1 wherein the drug pump has a stop mode and a start mode, further wherein the processor has a first state wherein the processor is responsive to a predetermined key stroke and a second state wherein the processor is unresponsive to the predetermined key stroke, the drug pump further comprising circuitry configured to automatically change the processor from the first state to the second state when the drug pump changes from the stop mode to the start mode.

16. A drug pump for dispensing fluid to a patient, the drug pump comprising:

a pump mechanism;

an external communication port;

a processor being in electrical communication with the pump mechanism and in electrical communication with the external communication port, the processor being programmed to communicate with an external processor via the external communications port; and

a sensor in electrical communication with the processor, the sensor configured to detect when a communication cable is connected to the external communication port and to send an electrical signal to the processor in response to detection of the communication cable.

17. The drug pump of claim 16 wherein the processor and the external communication port are configured to provide data communication according to the RS232 standard.

18. The drug pump of claim 17 wherein the external processor is in a remote drug pump.

19. The drug pump of claim 17 wherein the external processor is in a computer.

20. The drug pump of claim 16 further wherein the signal generated by the sensor is an interrupt signal that interrupts operation of the processor.

21. A drug pump for dispensing fluid to a patient, the pump system comprising:

a pump mechanism for pumping fluid;  
a microprocessor configured to control the pump;  
memory internal to the pump and electronically connected to the microprocessor, the memory storing a boot program and a plurality of application programs, one of the application programs being a predetermined application program; and

wherein the boot program is configured to launch the predetermined application program and the application programs are configured to control operation of the pump.

22. The drug pump of claim 21 wherein each application program implements a fluid delivery algorithm, the fluid delivery algorithm controlling the amount of fluid that is delivered and the time the fluid is delivered.

23. A method of operating a pump wherein the pump includes a microprocessor and memory in electrical communication

with the microprocessor, the memory storing a boot program and a plurality of application programs, one of the application programs being a predetermined application program, the method comprising the steps of:

- applying power to the microprocessor and the memory;

- executing the boot program;

- launching the predetermined execution program;

and

- executing the predetermined application program, wherein the predetermined execution program controls operation of the pump.

24. A drug pump for dispensing fluid to a patient, the pump comprising:

- a pump mechanism;

- a control system electrically connected to the pump mechanism, the control system including a processor and a keyboard, the keyboard being electrically connected to the processor, the processor being programmed to respond to predetermined keystrokes, the processor being further programmed with a plurality of access locks; and

- wherein each access lock, when activated, prevents the processor from responding to a set of predetermined keystrokes.

25. The drug pump of claim 24 wherein the pump has a first state in which the pump mechanism does not dispense fluid to the patient and second state in which the pump mechanism does dispense fluid to the patient, one of the access locks being a predetermined access lock, the processor being further configured to automatically activate the predetermined access lock when the pump changes from the first state to the second state.

26. The drug pump of claim 25 wherein each set of predetermined key strokes corresponds to a unique function.

27. A method of operating a drug pump comprising the steps of:

a) unlocking an access lock of a processor of a drug pump;

b) reprogramming a memory of the drug pump connected to the processor after the access lock is unlocked; and

c) after step b), automatically relocking the access lock.

28. A drug pump for dispensing fluid to a patient, the drug pump comprising:

a pump mechanism, the pump mechanism including a motor and a motor controller;

at least one sensor;

a serial communication device electrically connected to a communication port;

a processor; and

a data bus, the data bus providing electrical communication between the processor and the motor controller, the at least one sensor, and the serial communication device.

29. The drug pump of claim 28 wherein the at least one sensor is an external communication sensor, the external communication sensor configured to generate a signal when a communication cable is connected to the communication port.

30. The drug pump of claim 29 wherein the at least one sensor is an air detector configured to generate a signal when air is detected in the fluid being dispensed to the patient.

31. The drug pump of claim 30 wherein the at least one sensor is a temperature sensor configured to generate a signal indicative of the ambient air temperature.

32. The drug pump of claim 31 wherein the at least one sensor is a motor position sensor configured to generate a signal indicating the position of the motor.

33. A control system configured to interface with a remote pump and a remote telephone, the control system including:

a control unit configured to interface and control the remote pump, the control unit having a serial communication port configured for data transmission according to the RS 232 standard;

a telephone; and

a modem configured to simultaneously transmit and receive voice and data information, the modem being operably connected to the telephone and to the serial communication port of the control unit.

34. The control system of claim 33 wherein the control unit is a drug pump configured to transmit data to the remote pump, the control unit being configured as a master unit and the remote pump being configured as a slave unit.

35. The control system of claim 33 wherein the control unit is a computer.

36. The control system of claim 35 wherein the computer is an IBM-compatible personal computer.

37. The control system of claim 33 wherein the modem is configured to digitize the voice information and to





sensor configured to detect the lock, the processor configured to disable the pump mechanism upon a failure to detect the lock.

41. A method of operating a drug pump comprising the steps of:

- a) selecting a pump operating program from a plurality of different pump operating programs stored on the drug pump;
- b) inputting patient specific settings to the drug pump;
- c) pumping fluid to a patient with the drug pump;
- d) linking the drug pump to a remote caregiver drug pump over a modem connection; and
- e) inputting a further patient specific setting to the drug pump from the caregiver drug pump over the modem connection.

42. The method of claim 41, further comprising the steps of:

- a) connecting the drug pump to a personal computer and to a fluid analyzer;
- b) operating the drug pump through control signals sent from the personal computer; and
- c) collecting fluid at the fluid analyzer from the drug pump.

43. The method of claim 41, further comprising the steps of:

- a) sending status report data from the drug pump to the caregiver drug pump before step e); and
- b) status report data from the drug pump to the caregiver drug pump after step e).